Michaelis, (G.)

THE

INTRODUCTORY ADDRESS

OF THE

SIXTH LECTURE COURSE

OF THE

ALBANY COLLEGE OF PHARMACY

Delivered October 4, 1886,

BY

GUSTAVUS MICHAELIS, PH.G.,

Professor of Pharmacy.

PUBLISHED BY THE CLASS.

ALBANY, N. Y.:
BURDICK & TAYLOR, PRINTERS, 481 BROADWAY,
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CORRESPONDENCE.

Albany College of Pharmacy, *October* 16, 1886.

Prof. Gustavus Michaelis:

Dear Sir—At a meeting of the senior class of the Albany College of Pharmacy a vote was given unanimously that a committee be appointed to request of you the manuscript of the introductory address delivered by you at the opening of the sixth lecture course, on October 4, 1886.

Very respectfully,

J. Ewd. Mace,
E. F. Hunting,
I. W. Keller,
Committee.

Albany, N. Y., *October* 26, 1886.

Gentlemen—In compliance with your request of the 16th inst., I take pleasure to hand you the address delivered at the opening of the sixth annual lecture course of the Albany College of Pharmacy Please to return my thanks to the members of your class for the honor conferred.

Yours very truly,

G. Michaelis.

To Messrs. J. Ewd. Mace, E. F. Hunting, I. W. Keller, *Committee.*

THE GRADUAL DEVELOPMENT OF PHARMACY.

Gentlemen—To me is assigned the pleasant duty of bidding you welcome to-night on this the occasion of the opening of the sixth lecture course of the Albany College of Pharmacy, and I am sure that you will find yourselves welcomed by all those who have the honor and prosperity of the college at heart. I greet you with the greater pleasure, as the absolute certainty that *this* college is one of the growing institutions of its kind in the country is evident to all. We can, indeed, *justly* feel proud if we look upon the success which the school in its short career has achieved. What, a few years ago, was thought to be of a rather experimental nature is to-day an established fact, and the college is based upon a firm foundation. Not a small amount of this success, however, is due to the passing of pharmaceutical laws which close the doors to incompetent and unscrupulous adventurers. The passing and enforcing of these laws is a step in the right direction, and at once elevates the pharmacist from a common business man to the rank of a professional scientist. Indeed, no other calling deserves the name of a scientific art as well as the calling of the apothecary; in short, "pharmacy is a complex science."

Pharmacy can be divided into two distinct parts, the theoretical and the practical. If we look upon pharmacy from a purely theoretical standpoint, we can at once perceive that it is of the widest possible range, and embraces the knowledge of all the natural sciences. Plants, animals and minerals serve in their turn as medicine, and call for the knowledge of botany, materia medica, mineralogy, etc.; but it is not very often the case that the plants, the minerals or the animals enter into medicine in their crude or unprepared state, but must undergo various and often very elaborate treatment before they

can become useful agents in the hands of the pharmacist and the physician. Such treatment can, again, be two-fold—either of a mere mechanical or of a chemical nature, and the pharmacist should, therefore, possess a certain knowledge of inorganic and organic chemistry and be acquainted with the fundamental laws of natural philosophy.

My young friends, you can readily understand from these few words that the work which is expected from you, as future pharmacists, is great and not an easy task, and that it is, therefore, essential for you to put the shoulder to the wheel at the beginning of your pharmaceutical education. If you possess the necessary will power to execute your intentions, to grasp within your mind the great, wide field, you will come out victorious—you will surely solve the problem and leave the college covered with laurels, an honor to yourselves and your teachers, and become useful members of the community. You must not lose sight of the fact that you can learn something every day—that the sum total of each day's study will eventually be quite large, and will bring you the long-sought-for reward. You will find the *theories* expounded and the facts *explained* in the lectures useful in your every-day vocation, be it behind the prescription counter or in the laboratory. Theory and practice are sisters, and both essential to the student; with the knowledge of only one of them a full understanding of the science of pharmacy is absolutely impossible.

It has been remarked that theory and practice bear the same relation to each other as qualitative and quantitative science, and are in reality only two stages of the same. That this is true is well borne out by facts; for if we look back upon the history of science, we find that at first all science simply consisted in the recognition of the properties of bodies. The characters were made out which distinguished this thing from that and one kind of effect from another. The first thing was to determine the *qualities* of objects, and this was the work in the early or *qualitative* stage in the progress of science. But, qualities being ascertained, the next and inevitable step was to bring them under the operation of mathematics, which deals with the laws of quantity. First it was asked, "What are the properties or effects?" and next, "What are their degrees, or what quantities are involved in given results?" This implies exact measurement, and is known as the quantita-

tive stage of science. For example, bodies which burn and produce heat have the property of combustibility, but the next question is, "How much heat will different bodies produce in burning?" It is a quality of sulphuric acid to combine with soda, and this was ascertained in the qualitative infancy of chemistry, but the question of how much acid will combine with a given amount of soda was only answered with the development of quantitative chemistry. It is a quality of animals that they exhale carbonic acid gas in respiration, but, when this was known, it became necessary to learn the rates of exhalation in the different tribes, and the variation of these rates in sex, age, activity, sleep and disease; therefore, qualitative information is the first indispensable step in the growth of knowledge, and it is just as truly "science" as the knowledge of quantities.

We find similar stages in the science of pharmacy. Its development has been very gradual, and it has taken two thousand years and more to bring it to the present elevated state. I shall endeavor, to-night, to speak of a few of the more important facts which were instrumental in the advancement of pharmacy.

We must presume that our ancestors have suffered from the same ailments as the present human race, and what was more natural for mankind than to look for matters and substances which would neutralize these ailments — in short, to look for medicines? A long time, however, must have elapsed before even the first qualitative remedial properties of certain matters were discovered; but it is impossible to locate these periods with even the least degree of certainty. We find the Chinese, thousands of years ago, with a well-developed medical system and an innumerable variety of matters with which to banish disease. These remedies were mostly used in the crude state and seldom subjected to what we may call pharmaceutical manipulation.

With the introduction of stills and a perfect system of distillation, pharmacy at once gains a variety of prepared medicines; numerous medicinal waters are introduced into the materia medica, extracts from plants are prepared, and we find with the Greeks and Romans a variety of pharmaceutical preparations such as we make use of at the present day. There are the juices, decoctions, infusions, extracts, electuaries, powders and pills for internal use, and the washes ointments, plasters, poultices, liniments and suppositories serve for external application. As remedies, alcohol and sugar, aloes, opium, cantharides and a

large number of other substances belonging to the organic materia medica are mentioned; and here begins a new era for pharmacy, ushered in by the publication of numerous literary works which treat partially of materia medica and partially of pharmaceutical manipulation. A large number of these books were forwarded to the great university of Alexandria, where medicine and pharmacy were then for the first time taught and treated of as independent sciences. At this period we find also ideas and theoretical speculations proposing to resolve matter into its elements. There was Thales, who tried to prove that water was the fundamental element of matter, Anaximander ascribed it to the air, while Heraclit pleaded in favor of fire, and last, but not least, Aristoteles, who founded a philosophical system upon the four properties of matter, such as heat, cold, wet and dry, and to which he added a fifth element which he called the *essentia quinta.*

The first public pharmacy was erected in Bagdad about the eighth century, and then only a short time elapsed before laws were made which regulated the sale and composition of the different preparations, and official books published similar to our dispensatories and pharmacopœias.

PHARMACY AND INORGANIC CHEMISTRY.

One of the next marked advances in pharmacy is noted by the introduction of a number of pharmaceutico-chemical preparations. These came into use in the beginning of the fifteenth century, when the mercurial and antimonial preparations, which as chemicals had been known for some time, were brought into medical use. The road once opened, organic materia medica for a time lost its grip upon the minds of physicians and druggists, and in the next two centuries an astonishingly large variety of medicines originating from the inanimate world are introduced.

But, during all these years, the natural sciences, in their wide sense, were also enriched by a very large number of discoveries of the greatest importance, and these, in return, could not remain without influence upon the progress of pharmacy and chemistry. We possess works on pharmaceutical chemistry of that period which treat exhaustively of distillation, sublimation, evaporation, precipitation, etc., and give also numerous prescriptions for the preparation of syrups, tinctures, powders, etc., some of which are still in use. Already at that time the great importance of chemistry to pharmacy was fully recog-

nized, and it was then deemed impossible for an apothecary not to be also a chemist. What is more natural than that, under these circumstances, chemistry played the most important part in pharmacy, that most chemical discoveries were made by pharmacists, and that almost each day added one or another new compound to the already large number of preparations. And right here begins a new phase for *chemistry*. Heretofore it had always been tried to define matter from a mere qualitative point of view, but now the minds of chemists began to look for the quantitative composition of matter.

PRIESTLY'S DISCOVERIES.

Preparatory to this new phase, and really the forerunner, was the discovery of the composition of air, followed by the discovery of oxygen. This has had an immense influence upon the development of the science, without which we pharmacists cannot exist, and I deem it proper to call your attention to the man who has done such great service to mankind. Dr. Joseph Priestly, a clergyman and a chemist, lived in Leeds, where he served as pastor of a large congregation. We find written about him that he happened to reside near a brewery, and accidentally observed that beer, during its fermentation in the vats, gave forth a remarkable aerial substance. The flame of a lighted stick immersed in it was at once extinguished, and the smoke floating on the top of the stratum showed that it was very heavy, a result which was perfectly confirmed by the observation that, invisible and intangible as it was, it could be poured from vessel to vessel like water; it would overflow the edges of the vats in which it originated and descend to the floor, along which it would run like a stream, its course being readily tracked by the expedient of putting a lighted stick into it and observing the extinction of the flame. Priestly found, moreover, that it would dissolve in water, for, if dishes of that liquid were placed where the gas had access to them, an agreeably acidulous and sparkling fluid was formed; and further, that the agent that brought all these results about possessed a remarkable physiological potency was proved by the fact, *too* often known in such manufactories, that if it was breathed by accident, death at once would take place. This substance was then called "fixed air," and is familiarly known to us as carbonic acid gas.

In the year 1774 he made the splendid discovery of oxygen, which he developed by heating red oxide of mercury in a small

glass retort. He obtained the gas together with some drops of metallic mercury. As the sustainer of life, he applied to it the epithet "vital air." When it is remembered that this wonderful substance is the active element of the atmosphere and essential to the existence and activity of the entire living world—that it enters largely into the composition of all the natural objects around us, forming three-fourths the weight of the rocky strata and eight-ninths of the ocean; and, moreover, that it is an element of great chemical energy, and is involved in nearly every transformation of matter in the laboratory of nature, and in the arts, we shall be prepared to comprehend the significance of its discovery. It has given us a new chemistry and a new physiology, and probably carries the mind of man deeper into the order of nature than any other single scientific revelation ever made.

Priestly did not stay in his own country, but immigrated to the United States during 1794. He died in 1804 in Northumberland, Pa. Is it not a wonder that another chemist, Scheele, a Swede, should have made the same discovery at about the same time as Priestly, and that, nevertheless, neither of them were capable of drawing the conclusions of their discovery to its utmost limit? This was left for the eminent French chemist, Lavoisier, who unraveled the mystery which surrounded oxygen. He proved the elementary nature of the gas beyond doubt, and showed that the phenomena of combustion was, in fact, a chemical process—the combination of matter with oxygen. He proved this by weighing the products.

This discovery introduced the first element into chemistry and formed a tangible basis for a quantitative or exact science. Justice demands us to admit that while Priestly was the Copernicus of chemistry, Lavoisier became its Kepler. This unfortunate, but rarely gifted, man died by the hands of his own countrymen, a political martyr. His head fell under the guillotine on the 16th of Floral, in the second year of the French republic. It is easily understood what powerful influence *such* a discovery exercised upon scientists, and what fruit has it brought forth!

Gentlemen, it would be a hopeless undertaking to even enumerate in the few minutes allotted to me to-night the vast amount of material which has been unearthed since this discovery.

There is the elimination of hydrogen from the water, followed by the discovery of the metals of the alkaline earths,

together with a number of other elements and the introduction of a legion of new compounds. Such a fruitful time as this was never seen before in any science. A score or two of years were sufficient to develop a full analytical system both of the inorganic and organic chemicals, and headed by Gay-Lussac, Liebig, and a hundred other chemists, began the examination of the organic compounds produced by nature.

Chemistry has been called the most useful of all sciences, and this is indeed true in the fullest and widest sense of the word. The arts, the industries, every-day life, and *last*, but not *least*, pharmacy, have received immeasurable benefit from the development of inorganic, as well as of organic, chemistry.

It would bring me too far from the scope of this lecture if I should undertake to roll up before your eyes a picture of the influence which both branches of the science have exercised upon the development of pharmacy, and, even taking one branch only, I have to restrict myself to the organic portion of chemistry, and select at random a few specimens from the vast amount of material at my disposal. As such I have chosen the organic alkaloids in a general, and the glycerin in a special, way.

ALKALOIDS.

The organic alkaloids or organic bases are chemical compounds which occur either naturally, or they may be artificially produced in our laboratories; they show as much similarity with the alkalies and ammonia as the organic acids do with the inorganic acids, for most of them have a decided alkaline reaction; that is, they turn red litmus paper blue and form yellow precipitates with platinum chloride, double salts of a very similar nature to the precipitate which is formed with ammonia. Many of them are capable of neutralizing the strongest acids. The alkaloids occur either gaseous, liquid or solid, and are sometimes volatile, sometimes non-volatile, dissolve with difficulty in water, much more easily in alcohol. Their solutions are precipitated by tannic acid, mercuric chloride, platinum chloride, etc., while with mercuro-potassic iodide they may be quantitatively estimated. The number of organic bases which have been *artificially* prepared is very large, and they are formed in various ways, but, with the exception of aniline, naphthaline, anthracene, and a few others, they are hardly known outside of the chemical world.

Just the opposite is the case with those organic bases which occur already formed by nature in the plants, and which have received the collective name, "alkaloids." They are, like many other chemicals, children of this century, for, in 1804, Serturner, an apothecary, prepared the first organic alkaloid, morphia. Unfortunately his discovery occurred at a time when the minds of the most eminent chemists of his time were occupied with the study of inorganic chemistry—a time when hardly the metallic nature of the alkaloids was proven. The production of a compound which possessed such similar properties with the metallic oxides came too early to excite the interest which it deserved. Thus fourteen years elapsed before his observations were verified, but he showed in another series of examinations, the results of which were published in 1816, that morphia was a body which was contained in the complex substance known under the collective name of gum opium, and that it possessed an undoubted alkaline character. Gay-Lussac and Robiquet prepared the alkaloid in the same manner as Serturner, by first extracting gum opium with water and precipitating the aqueous solution with ammonia. This crystalline precipitate was redissolved in alcohol, and thus morphia received in absolute purity.

The road once opened and the way shown, it was only a matter of experiment to ascertain that numerous other vegetable substances also contained alkaline bodies, and that, after their elimination, the remaining parts were entirely destitute of medicinal qualities. Thus Pelletier and Caventou discovered the cinchona bases in the calisaya barks, the strychnia in the fruits of strychnos nux vomica, not to speak of the hundreds of others of minor importance. The physician is now enabled to use morphia or codeia instead of the complex mixture, gum opium, which, in its totality, contains not less than twenty different chemical bodies, which are of heterogeneous medicinal qualities; he uses quinia and cinchona in place of the bulky infusion and tincture of calisaya bark; while strychnia in the form of a tasteless granule has taken the place of the nauseating tincture or solid extract of nux vomica. In one word, instead of mechanical mixtures, differing in composition and physiological effect, definite chemical compounds of constant efficiency have been placed at the disposal of the physician. I must not forgot to mention cocaine and its beautifully crystal-

lized salts, which of late play such a prominent part in general and ophthalmic surgery.

The alkaloids are either volatile or non-volatile, and, furthermore, contain either C, H and N or C, H, N and O. This allows of a very characteristic distinction, in fact a division into two classes, as those alkaloids which are free from oxygen are volatile, while those which contain oxygen are non-volatile.

The preparation of the volatile alkaloids is very simple; the plants, or parts of them, are distilled with water in the presence of an alkali, and after neutralization of the distillate with H_2SO_4, are evaporated to dryness; the residue is re-dissolved in alcohol, again evaporated and then distilled with KHO. The only volatile alkaloid which at present has some pharmaceutical interest is conia, discovered in 1831 by Geiger, and is contained in the leaves and seeds of conium maculatum.

For the preparation of the non-volatile alkaloids there is a very large number of different processes, which are, in the main, as follows: The crude comminuted material is extracted with water containing a small amount of HCl; the extract is filtered, supersaturated with KHO, and the precipitate collected and purified; or the extract is precipitated with acetate of lead for the elimination of coloring and extractive matter and filtered; the filtrate is then treated with H_2S to get rid of the lead, which is precipitated in the form of PbS; the filtrate is then concentrated, mixed with KHO, and the precipitated alkaloids are dissolved in a diluted acid; the solution is then discolored with animal charcoal, again filtered, and, after due concentration, precipitated with an alkali.

These methods can only be considered as intended to give you a general idea of how alkaloids are prepared in the laboratory, as in large manufacturing establishments each alkaloid is treated according to the individual ideas of the maker; all of them endeavor to get at the best results in the shortest time and with the least expense. I cannot, as I said at the beginning, enter into an exhaustive description of the *modus operandi* of each individual alkaloid, as my time is too short and as I intend to make a few remarks on the pharmaceutical chemical *par excellence*,

"THE GLYCERIN."

The career of this chemical is marvelous; for, a hundred years ago hardly known, it now plays a prominent part in

pharmacy and the arts. Glycerin was discovered in 1778 by Scheele, a German apothecary and excellent chemist. He found it while preparing lead plaster, in the water which he used to wash the finished product with. The liquid was named by him "Scheele's suess," and was fully investigated by Pelouze and Berthelot, two eminent French chemists, and these scientists, even at that period, mention the close relation which glycerin bears to common alcohol. Glycerin is found combined with fatty (and oleic) acids in most fats and oils of the vegetable and animal kingdom. It may be eliminated from them in various ways, as, for instance, by stronger basic hydrates, by treatment with H_2SO_4, by the influence of superheated steam, etc. Some fatty substances undergo decomposition into free acid and glycerin by simple exposure to the influence of moist air. Glycerin is found combined with H_3PO_4 in the yolk of the egg, in the brain, in the gall, etc., and, according to the researches of Pasteur, glycerin is also formed during the vinous fermentation of sugar (about three per cent.), and therefore all fermented liquids, such as wine and beer, contain some of it. The natural fats serve as the material for the preparation of glycerin, from which it is received by saponification. Of a number of different methods which have been proposed, only those have been able to compete successfully which allow of the formation of either *insoluble* fats or which produce directly *free* acids. Those methods by which it is intended to isolate the large quantities of glycerin formed during the process of soap-making on a large scale seem to have been unsatisfactory, as, *practically*, all the soap manufacturers allow it still to run to waste with the salt solution.

For the preparation of this chemical on a small scale, the old method of Scheele, although somewhat troublesome, may be pursued. Olive oil, or any of the natural fats, is boiled with litharge (oxide of lead) and water until saponification is effected. The formed lead plaster is then removed, the fluid matters remaining are separated and submitted to the action of sulphide of hydrogen, by which agent that portion of the metallic base which was left in solution is precipitated. After filtration the liquid is exposed to careful evaporation under 212° F. until all the water is expelled and a viscid fluid remains. *This is glycerin.* Prepared in this manner it is a faintly yellowish fluid, with an agreeable sweet taste, soluble in water and alcohol,

but not in ether. The alkalies, several metallic oxides and salts, more especially those which are known to deliquesce in the air, are dissolved by it to such an extent that it ranks next to water in solvent powers. It is a very stable compound, being persistent in air; it passes over *unchanged* when stilled at a moderate heat; it suffers *partial* decomposition when a temperature of 500° to 600° C. is used, but subjected to a heat *beyond* these temperatures it is *entirely* decomposed, being changed into ***acrolein*, acetic acid and inflammable gases.**

Up to about 1854 all the glycerine was prepared by Scheele's process, and as late as 1846 a Philadelphia pharmacist, R. Shoemaker, offered the first glycerin for sale as an article of commerce in the United States. He commenced in that year the manufacture of the plasters then officinal in the United States Pharmacopœia and of which empl. plumbi forms the base; this plaster naturally yielded large amounts of glycerin as a by-product, which he marketed at the value of $4.00 per pound. The sales for the first year reached about fifteen pounds. In 1849 the price was reduced to $3.00, and in 1850 to $2.75, per pound, and at this price the sales reached nearly two hundred pounds annually. But soon English glycerin of great purity appeared in the market, and it was sold at so much lower rates than Shoemaker could produce it that he was obliged to discontinue its manufacture. I am not sure whether he was a natural-born free trader or whether he did not know how to work the legislative corporations of his time; the bare fact remains that **he stopped the manufacture of glycerin.**

Before going on further, let us consider for a moment the chemical side of the production of glycerin. As is well known, the fats may be considered as neutral compounds of the fatty acids with the fatty bases, which are very similar to the so-called compound ethers. Most fats, as almond oil, olive oil, lard, suet, etc., are glycerides; that is, combinations of glyceryloxide with fatty acids. When a fat of this kind is brought in contact with an inorganic base which has a stronger affinity to the fatty acids than glyceryloxide, salts are formed. If, for instance, caustic soda and oil of almonds, which latter is a glyceride of oleic acid, are mixed and heated, oleate of sodium is produced. By the influence of soda upon olive oil, lard and tallow, oleate, margarate and stearate of sodium are formed, together with free glyceryloxide, which at the moment of its

formation combines with water to glycerin. This process of the elimination of the hydroxide of glyceryle, or shortly of glycerin, in connection with the combination of the fatty acids with an inorganic base, has been called, and is, "saponification." But such methods soon proved inefficient for the production of sufficient quantities of glycerin, and the busy minds of the technical chemists had to look for new means for its preparation. At the present time immense quantities of glycerin are produced as a by-product in the manufacture of candles; fats are also directly decomposed by superheated steam, and by their treatment in closed vessels with lime, in the presence of water, or, as is also often done, in the presence of sulphuric acid. The largest quantity and the purest glycerine is received if the fats are acted upon with lime, as during the treatment of the fats with concentrated H_2SO_4 a certain amount undergoes further decomposition; the yield is therefore not so large, and the product has a more colored appearance. The liquid received in either manner is a diluted aqueous solution of glycerin, which contains in one instance free H_2SO_4 and in the other $CaOH_2O$, and must be subjected to a further rectifying process. If the liquid is acid, it is neutralized by the action of lime or baryta, while, if the liquid is alkaline, it is subjected to treatment with H_2SO_4. The resulting neutralized liquid is evaporated in open iron pans to a specific gravity of 1.20 to 1.25, and then constitutes the crudest glycerine of commerce, and this must be refined for further purification. For this purpose it is diluted to a specific gravity of 1.07 and boiled with animal charcoal until all the coloring matter has been eliminated and all smell has disappeared; then the whole is filtered and finally concentrated in a vacuum. But even this so-called refined glycerin is, although colorless and free from smell, still a very impure liquid and entirely unfit for pharmaceutical and medicinal use. If it shall serve as a medicine, it must be subjected to a further purifying treatment. For this purpose the glycerine is again diluted with water, but, in this instance, only till it has reached a specific gravity of 1.15. The liquid is then introduced into a large still and steam of 100° to 110° C. temperature is run through for some time, in fact so long as the distilling product shows an acid reaction upon litmus paper or any other suitable reagent. As soon as the distilling product ceases to possess the above-described reaction the temperature of the steam is increased to 170° to 180° C. The glyc-

erin vapors which now come over with the steam are cooled by leading them through a long copper serpent, which is surronnded by cold water; the liquefied product is then concentrated to the proper specific gravity. Pure glycerine is a colorless and odorless thick liquid of a purely sweet taste and of a specific gravity of 1.267; it is very hygroscopic, and may attract moisture up to fifty per cent; it mixes readily with water and alcohol, but not with ether and chloroform, in which liquids it is perfectly insoluble. It bursts into flame when heated, exposed to the air, at about 150° C., while its boiling point is at 290° C.

But it is seldom the case that the so-called commercial glycerin offered in the market is of the purity desired by the pharmacist, and no glycerin should therefore be taken into pharmaceutical use except such as has been thoroughly tested.

There are numerous methods known by which we are able to determine the purity of glycerin in a very short time. The impurities present can be readily divided into mere contaminations arising from carelessness during the process of its manufacture, such as oxide of lead, lime, butyric and formic acids, or willful adulterations, as glucose, cane sugar, gum, etc. We possess a good qualitative test for the purity of glycerin in a solution of argentic nitrate. When pure glycerin is shaken with a solution of nitrate of silver, no turbidity will occur and no change of color will take place during twenty-four hours; any glycerin which stands this test may be considered as pure. Glycerin may also be tested in the following manner: Equal parts of chloroform and glycerin are violently shaken in a test tube and then allowed to separate. The chloroform, being specifically heavier, will sink to the bottom, and, if the glycerin is pure, will remain unchanged; if, however, the glycerin is impure, it will have a turbid appearance, or else a turbid layer—a zone—will be formed between the two liquids. The presence of lime salts can be ascertained by the addition of a few drops of diluted sulphuric acid to a mixture of equal parts of glycerine, alcohol and water, by the appearance of a white precipitate. If this precipitate turns black upon the addition of H_2S, the presence of a lead salt is proven. Glycerin, when heated with a mixture of H_2SO_4 and alcohol, will develop the peculiar odor of butyric ether, if butyric acid be present. The presence of formic and oxalic acids, which are also found as impurities in glycerin, are of special interest to the pharmacist. When equal parts of

glycerin and H_2SO_4 (s. g. 1.83) are mixed, no carbonic oxide gas will be given off if the liquid is pure, but if either of the acids are present, this gas will be evolved. To decide if both acids are present, and, if not, which one, some alcohol of 40° B. and one drop of H_2SO_4 are added and gently heated. Formic ether (essence of peach) will be recognized by its peculiar odor, and proves the presence of formic acid. To another sample of the glycerin a solution of $CaCl_2$ is added, which will give a precipitate of oxalate of lime, if oxalic acid is present. Common adulterants are water, syrup, cane sugar and mucilage. Water may be readily detected by the specific gravity, while cane sugar, glucose, dextrine and gum are detected when glycerin is shaken with equal parts of H_2SO_4, by the brown color produced. s have lately tested twenty-one different samples of glycerin, and I have found but few which would prove free from all impurities.

The physical properties of glycerin, such as its non-volatibility at ordinary temperatures, its dissolving power, etc., allow of a very diversified use; for instance, as a non-fermentable sweetener it is used in the manufacture of liquids and essences, for the preservation of fruit, etc, etc. The United States Pharmacopœia makes extensive use of its powerful dissolving properties in a number of pharmaceutical preparations. One of the most prominent applications of glycerin in this branch is its use in the preparing of fluid and solid extracts, tinctures and glycerites. Of the latter preparations it is to be regretted that all those formerly officinal were omitted in the last revision of the United States Pharmacopœia—at least two of them: I mean glycerite of carbolic acid and glycerite of tannin. Referring to the United States Pharmacopœia of 1880 it will be seen that glycerin enters into forty-two officinal preparations, of which I mention the following: Empl. ichthyocollæ, glyceritum amyli, glyceritum vitelli, liquor pepsinæ, massa hydrargyri, muc. tragac., pilul. phosph., syr. prun. virgin., tr. card. co., tr. cinch. co., and tr. cinchonæ. The use of glycerin with these tinctures shows particularly good judgment, as it is an excellent solvent for the cinchona alkaloids, and prevents to a great extent the formation of a precipitate in the finished tinctures. The same may be said in reference to tincture of galls and tincture of kino. When the last-mentioned tincture was prepared according to the United States Pharmacopœia of 1870 it would gelatinize in a short time, while this is almost entirely avoided when

prepared according to the present officinal formula. Of the one hundred and eleven fluid and solid extracts now officinal, twenty-eight, or about one-fourth, are prepared with glycerin. In the preparation of the fluid extracts, glycerin acts not alone as a dissolving agent, but also prevents to a great extent the formation of a precipitate in the finished product. The addition of glycerin to the solid extracts is of great value, as it helps to keep them pliable. Such is the case, for instance, with a mass like pilulæ col. co., which mass generally gets very hard. By adding to it a mixture of equal parts of glycerin and water in sufficient quantity, the mass will remain soft for an almost indefinite length of time. A very good *general* excipient for pills can be made by taking three parts of glycerin and one part of gum trag. and one part water, placed in a porcelaiu capsule and heated over a water bath for ten or fifteen minutes. The resulting mixture will be an opaque jelly, which keeps well, and answers whenever pills shall be prepared from powders, etc. Even as a direct solvent glycerin is much used in pharmacy. It dissolves many substances, such as tannic, salicylic and carbolic acids, the hypophosphites of sodium, calcium and potassium, the cinchona salts, morphine, borax, gum arabic, glue, the anilines, potassic and sodic hydrate, pepsine, and a great many others too numerous to mention. Added to collodion it renders it flexible, and it may be readily substituted for Canada balsam and castor oil.

Technically glycerin is prepared in large quantities for the manufacture of nitro-glycerin, which is made by allowing glycerin to come gradually in contact with a mixture of highly concentrated nitric and sulphuric acids. The use of this explosive agent as a medicine is, however, very limited, whereas, on the other hand, immense quantities are annually consumed in quarries and mines.

Gentlemen, I could could continue for hours without exhausting the subject, but this is not my desire. I merely intended to show how, from a small beginning, by the constant application of the busy minds of men, from orignally small things, great results have been achieved. Apothecaries have always been foremost in the ranks of investigating scientists, and if I have this evening planted in your hearts the desire to follow the steps of your great predecessors, I shall feel amply repaid.

Gentlemen, once more I bid you welcome in Albany.